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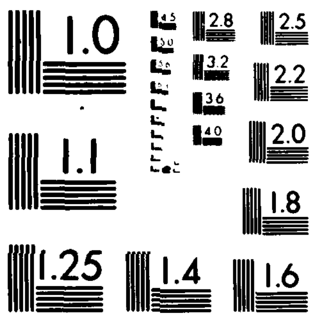

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Various alternatives to the present retirement system have been proposed with emphasis on curbing the rising trend in military retirement costs. Although retirement cost is a focus of these proposals; an important consideration is the impact that an alternative retirement system will have on the ability of the services to attract and retain an effective force. This paper discusses automated personnel retention models that evaluate the impact of proposed retirement systems on the retention of enlisted military personnel. The analysis consists of three chapters, supported by Appendices. Chapter 1 provides introductory material, a general discussion >over

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of all models and major observations. Chapter 2 concentrates on the methodology of a model, developed by the Air Force, and adapted for use on CAA's computer system. In Chapter 3, an analysis is presented which compares the output of the AF model using Army input data versus AF input data.

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PERSONNEL RETENTION MODEL ANALYSIS

January 1980

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FOREWORD

This technical paper documents an analysis of automated personnel retention models with particular emphasis on a model, developed by the Air Force, that was converted to run on the UNIVAC 1108 computer at CAA. The primary purpose of the analysis was to provide the Army with an automated capability to evaluate the impact of proposed changes to the present military retirement system on the retention of military personnel.

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PERSONNEL RETENTION MODEL ANALYSIS

CHAPTER 1

INTRODUCTION

1-1. PURPOSE. The Office, Deputy Chief of Staff for Personnel (ODCSPER), requested that the US Army Concepts Analysis Agency (CAA) perform an analysis of personnel retention models. The purpose of the analysis was to provide ODCSPER with an automated capability to evaluate the varying economic considerations of alternative retirement systems and the impact of the alternative systems on retention of military personnel.

1-2. BACKGROUND. Various alternatives to the present retirement system have been proposed with emphasis on curbing the rising trend in military retirement costs. Although retirement cost is a focus of these proposals, an equally important consideration is the impact that an alternative retirement system will have on the ability of the armed services to attract and retain an effective force. Several models, commonly called personnel retention models, have been developed to evaluate the impact of alternative retirement systems on retention behavior. Included in this category are models that were developed by, or for, the Air Force, the Navy, and the Office of the Secretary of Defense (OSD). The Army lacked an automated capability to analyze alternative retention systems. Therefore, its ability to evaluate proposals made by the President's Commission on Military Compensation (PCMC), OSD, and the other services was limited.

1-3. SCOPE. This paper documents the personnel retention model analysis performed by CAA. Chapter 1 presents specific objectives of the analysis and describes how each of the objectives was met. The major observations that resulted from this analysis are also included in this chapter. Chapter 2 presents a discussion of the methodology employed in the AF model. In Chapter 3, an analysis that compares the output of the AF model with Army input data versus AF input data is presented. In addition, a series of appendices provides information and data in support of the retention model analysis.

1-4. OBJECTIVES. The personnel retention model analysis was a two-phased effort which included the objectives listed below. This paragraph also describes what was done to satisfy each of the objectives.

a. Phase I objectives were:

(1) Investigate the AF and OSD personnel retention models.

(2) Convert these models for operation at CAA if appropriate.

(3) Identify model input requirements for Army purposes.

(4) Provide insights to the Department of the Army (DA) Staff for the next PCMC meeting.

b. Phase I objectives were met as described below.

(1) All available personnel retention models were reviewed. The analysis focused on models developed by the Air Force and by the Center for Naval Analyses (CNA) under contract to the OSD. These models were specifically identified as candidates for review by ODCSPER. Three other models were also reviewed as a part of this analysis. They include models by Rand Corporation, the Congressional Budget Office (CBO), and the Navy Personnel Research and Development Center (NPRDC). The Rand Model was the pioneer effort in personnel retention analysis, and it served as a basis for the other four models cited above. The model review process consisted of: (1) discussions with Air Force and CNA model developers, (2) a review of a paper[1] by Mr. Mark Chipman (NPRDC) in which all five models are documented, and (3) an analysis of source program code for the AF model.

(2) The AF model was converted to run at CAA. Paragraph 1-4 addresses why it was selected over the OSD model, and Chapter 2 presents a detailed discussion of its methodology.

(3) Army input data requirements were identified, and they are presented in Appendix C of this paper.

(4) The operation of the AF model provided insights as to potential Army retention trends under the PCMC proposals. As will be discussed in Chapter 3, the AF model estimates that Army reenlistments will increase under the PCMC proposals during the 1- to 10-year and the 21- to 30-year intervals. However, because the PCMC would offer for the first time a monetary incentive after 10 years of service, the model estimates that Army reenlistments will decrease during the 11- to 20-year interval.

c. Phase II objectives were:

(1) Task the DA Staff to provide necessary input data and operate the converted model(s) with the Army data.

(2) Develop an Army personnel retention model if appropriate.

d. The objectives of Phase II were to be addressed dependent upon the findings of Phase I and further direction from ODCSPER. These objectives were addressed to the extent indicated below.

(1) Operation of the AF model with Army data was not requested. However, the input data requirements identified in Appendix C were presented to the Staff. Some tentative data were provided to CAA, and these data were input to the AF model. Chapter 3 identifies those model parameters for which data were received, and it discusses how these data were used to meet the fourth objective of Phase I.

(2) A unique Army model was not developed as part of this analysis. A specific requirement to develop an Army model was not set forth by ODCSPER. However, the analysis conducted to meet Phase I objectives provided CAA the capability to construct an Army-unique model if a future requirement for this task should arise.

1-5. OBSERVATIONS. The major observations resulting from this analysis are listed below.

a. All of the models that are being used to forecast enlisted retention behavior under various alternatives to the current retirement system are economic models. The underlying assumption is that an individual will choose to leave or to stay in the military based on which choice maximizes future expected earnings. Accordingly, all of the models relate changes in retention behavior to changes in the economic incentives of a given retirement system. The assumptions imbedded in these models imply that altering the income stream an individual expects to receive (from staying in the military) alters the probability that the individual will choose to leave military service.

b. Although all of the models might produce different retention estimates for the same retirement system, a major contributor to these differences is the data input to the models.

c. Due to time constraints, the AF model (FORTRAN program) was selected for conversion to run on the CAA 1108 UNIVAC computer. The OSD model was written in A Programming Language (APL) which is computer specific (Burroughs) and therefore would have been more difficult to convert. Also, the strong similarities between the two models, as detailed in the Chipman paper,[1] indicated that the effort involved in converting the OSD model in addition to the AF

model was not warranted. The Chipman paper is a good source for general contrasts in the methodologies of all five models.

d. The AF model produced similar behavior in Army and AF reenlistment trends under the alternative system proposed by the President's Commission on Military Compensation. However, the Army reenlistment rates are generally lower than AF rates. This is a function of lower reenlistment rates that were input to the model as representative of Army reenlistment experience under the present retirement system. It was observed that the same reenlistment rate was provided by ODCSPER for Army enlisted personnel with anywhere from 8 to 19 years of service. Intuitively, it is expected that the rate would vary significantly as a function of years of service within the 8- to 19-year interval. Future analysis should focus on improving the validity of input data.

CHAPTER 2

AIR FORCE MODEL

2-1. GENERAL. The AF model estimates retention under alternative retirement systems for the enlisted career force. These estimates are made for pay grades E4-E9 and for years of service (YOS) 5-30. A basic assumption of the AF model is that members of the enlisted career force will base their decision, to leave or to stay in service, solely on economic considerations. Further assumptions imply that the careerist is knowledgeable of economic and probability techniques and will use them to evaluate the monetary benefits of alternative retirement systems over a lifetime earning horizon. First term personnel were not considered. The Air Force defines first term personnel as those individuals with less than five years of service. Since this group is generally younger and discounts future money more heavily than the older careerists, they would be influenced more by current military pay than by the deferred compensation offered by a retirement system. Limitations of the model's current configuration are discussed in paragraph 2-8.

2-2. OVERVIEW. The methodology of the AF model involves the five basic modules shown in Figure 2-1. Various input data are processed to produce three different output parameters: earning streams, reenlistment rate estimates, and estimates of overall continuation rates. The model then compares the value of various parameters under the current and proposed system by pay grade and years of service. Each module is discussed briefly here with more detail provided in paragraphs 2-3 through 2-6. Input data in the form of survival rates, promotional probabilities, and average civilian wages for high school graduates are used to compute earning streams. These streams represent the return for a decision to stay (RS) and the return for a decision to leave (RL) military service under the current retirement system. The delta, or change, in these returns impacts the individual's decision in that he will stay in the military as long as RS is greater than RL. Similar streams are computed also for a specified alternative system. An alternative to the present system impacts this decision by altering the value of the returns. The model mathematically relates the changes in returns and the reenlistment rates under the current system to predict reenlistment rates for the alternative system. A key consideration is the magnitude of effect (reenlistment elasticity) that a change in money will have on reenlistment rates. Reenlistment rates are only applicable to that segment of the force which has completed its obligated term of service and is free to stay in or leave military service.

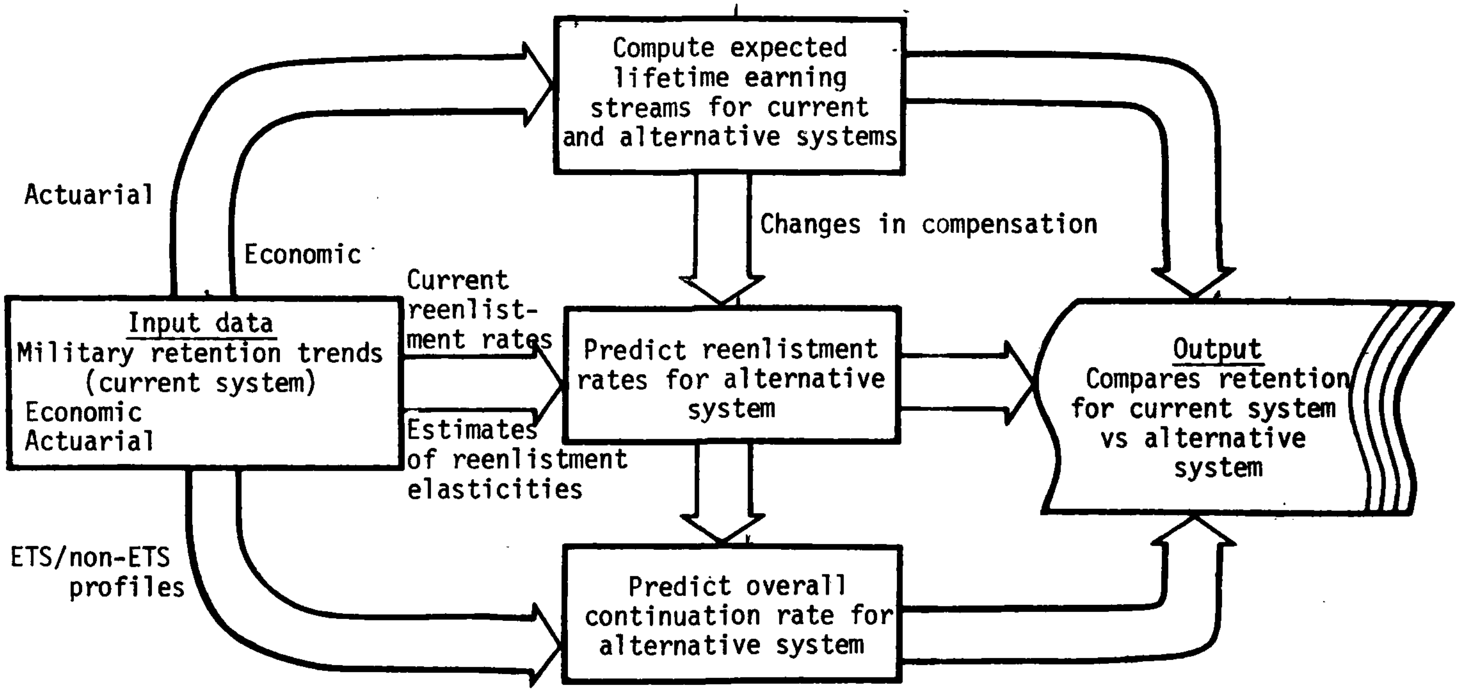


Figure 2-1. Overview of AF Personnel Retention Model Methodology

This segment is known as an expiration of term of service (ETS) group. Overall continuation rates under an alternative system must also reflect the actions of individuals who have not completed their ETS and therefore must remain in the service barring discharge, disability, or death. Therefore, the model simulates the force profile as to ETS and non-ETS groups. This simulated profile and the reenlistment rates predicted for the proposed system are used to predict overall continuation rates for the alternative.

2-3. INPUT DATA. The model uses three major categories of input data: military retention trends under the current system, actuarial data, and economic data. Figure 2-2 presents the variables included in each of these categories. Note that preliminary Army inputs were obtained for most of the variables as indicated by the "U." Indicated by the asterisk (*) are discount rates, civilian pay, regular military compensation, and the retirement pay for the retirement system being considered. These items are basically service independent for a given pay grade and length of service. Therefore, it was assumed that AF inputs would be fairly representative of Army inputs. Inflation would be the primary factor affecting these variables. Appendix C presents brief definitions for each of these variables.

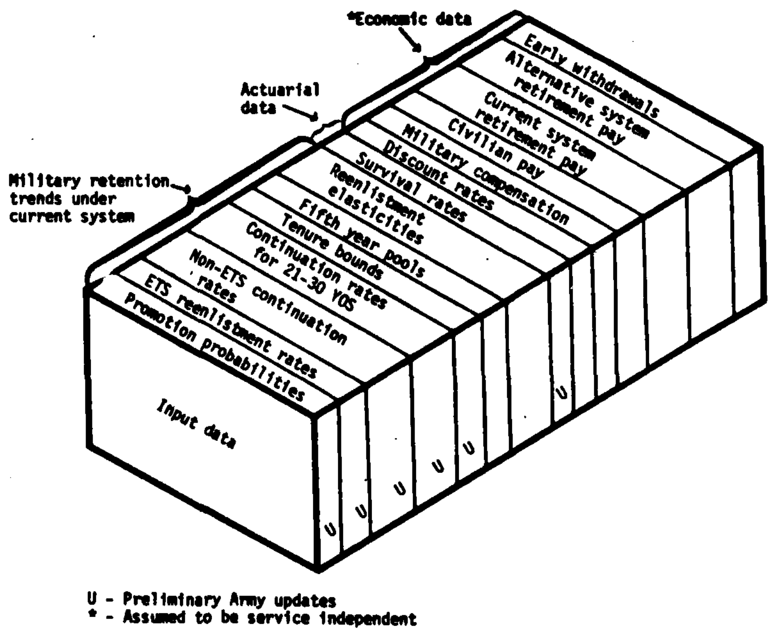


Figure 2-2. Air Force Model Input Data

2-4. EXPECTED EARNING STREAMS

a. The model computes expected future earning streams associated with an individual's decision to leave or to stay in military service. The computations consider wage growth, discounting theory and due course promotions for military service and average civilian wages paid to high school graduates. Figure 2-3 is a simplistic representation of the methodology used to model the individual's basic options: to leave now, or to stay at least one more year and leave at some future date. The options are the same whether the individual is serving under the current retirement system or a proposed alternative system. Although the options are basically independent of the retirement system, the monetary return that the individual receives for a given option could vary significantly between retirement systems. The concept of differing monetary returns is illustrated by the two types of money pots. Solid pots represent returns for the current retirement system, while the dashed pots represent returns for an alternative system. These returns (earning streams) are computed annually and are based on the likelihood of the individual either leaving or staying in service during the year under consideration. The values used for the likelihood of a given decision differ depending on whether the individual has completed his obligated tour of service and is eligible to ETS. In Figure 2-3, this likelihood is expressed as the probability of staying (P(S)) and the probability of leaving (P(L)). For example, the model developer assumed that Air Force personnel face a reenlistment decision once every four years prior to completing 20 YOS. After the 20 YOS point, he faces the decision annually. Therefore, voluntary reenlistment rates are used as the likelihood of a given decision for those years in which a reenlistment decision is possible, whereas continuation rates are used for those years in which a decision is not possible. Consequently, if a person had completed 5 YOS, the model uses voluntary rates for years 5, 9, 13, 17, and 20-30 and continuation rates for all other years.

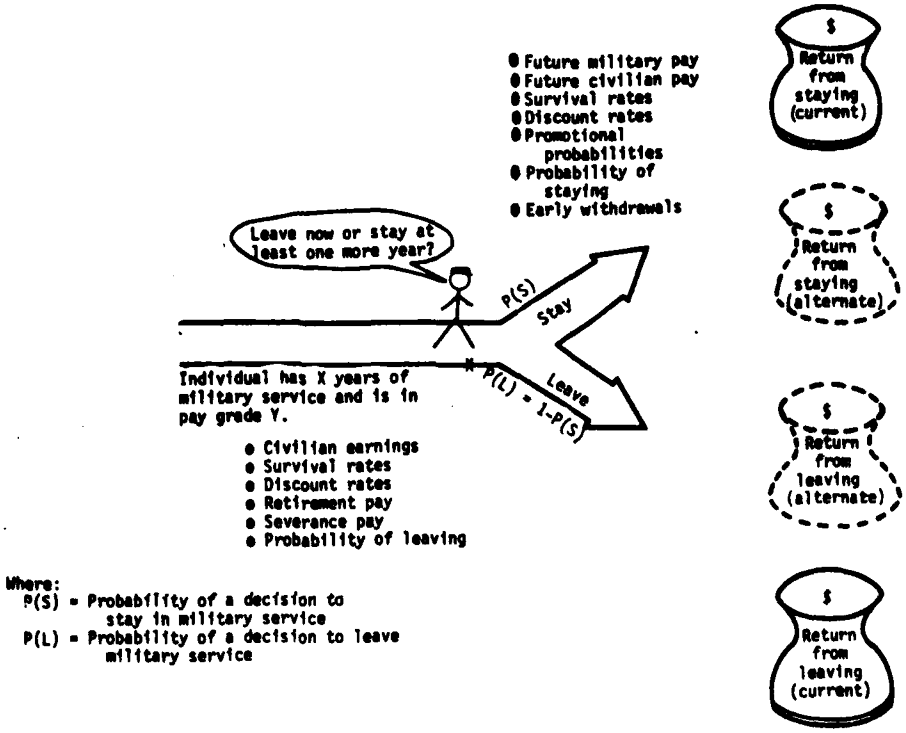


Figure 2-3. Present Value of Expected Lifetime Earning Streams

b. The return from a decision to leave military service (RL) is a more direct computation than is the return from a decision to stay at least one more year (RS). This is true because when a person leaves the military, his expected future earning stream is just the sum of future civilian pay and his military retirement annuity. However, in computing the return from staying, we have

to allow for his eventually leaving the service. Therefore, this return is a function of regular military compensation as well as future civilian earnings and retirement annuity. In computing future military pay, the model must allow for promotional opportunities and for the individual to leave the service in some future year. According to the Chipman paper, these returns can be represented mathematically as:

$$RS_{jk} = \sum_{i=k}^{\text{Age } 65} \prod_{m=k}^{i} \left[\sum_{n=1}^{9} (C_{nm} \cdot P_{nm}(j,k)) \cdot (RMC_{in} + EW_{in}) \right]$$

$$\cdot \left(\frac{1 + W}{1 + D}\right)^{i-k} + \sum_{i=k}^{\text{Age } 65} (1 - \prod_{m=k}^{i} (\sum_{n=1}^{9} (C_{nm} \cdot P_{nm}))$$

$$\cdot (CIV_i + RET_{j,i,i})) \cdot \left(\frac{1 + W}{1 + D}\right)^{i-k}$$

and:

$$RL_{jk} = \sum_{i=k}^{\text{Age } 65} (CIV_i + RET_{j,i,k}) \cdot \left[\left(\frac{1 + W}{1 + D}\right)^{i-k}\right]$$

where:

C_{nm} = probability of remaining in the Air Force from the end of YOS (m-1) to the end of YOS m given the individual is in pay grade n (C_{nm} = 0 for m > 30)

$P_{nm}(j,k)$ = probability of being in pay grade n YOS m given the individual is in pay grade j in YOS k and remains in the Air Force to YOS m

RMC_{in} = regular military compensation in YOS i for pay grade n

EW_{in} = any early withdrawal money earned in YOS i for pay grade n

CIV_i = civilian salary that could be earned by an individual (i+19 years old)

$RET_{j,i,k}$ = military retirement annuity for pay grade j earned in year i (adjusted for any early withdrawals) given that the individual leaves the Air Force in YOS k

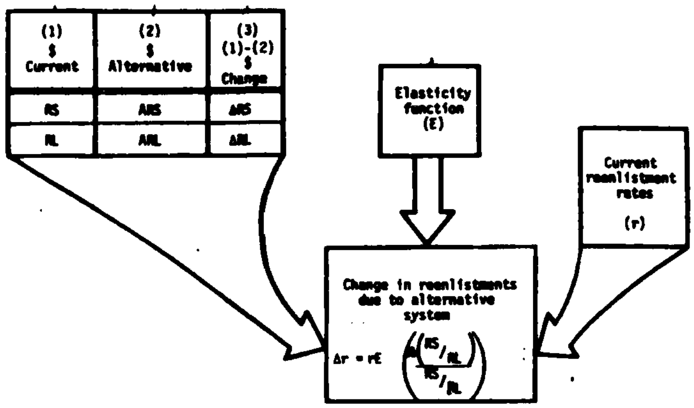
W = annual real wage growth

D = annual real discount rate.

c. Expected civilian pay is based on the average wage earned by a high school graduate. Total expected civilian earnings incorporate the likelihood that the individual will survive until a given age.

2-5. ESTIMATES OF REENLISTMENT RATES FOR AN ALTERNATIVE SYSTEM

a. To estimate changes in reenlistment rates under an alternative system, the model mathematically relates the earning stream for staying and the earning stream for leaving to the current reenlistment rates. Figure 2-4 summarizes how these estimates are made. The effect of the alternative retirement system can be handled as a delta to the current system. For example, the change in return for a decision to stay (ΔRS) is simply the return under the current system (RS) less the return under the alternative (ARS) or ΔRS = RS - ARS. Since civilian pay is independent of the retirement system, the change in return for a decision to leave military service (ΔRL) is just retirement pay under the current system (RL) less retirement pay under an alternative system (ARL) so that ΔRL = RL - ARL.



E = Function of the change in reenlistments that is produced by a 1 percent change in compensation

Figure 2-4. Estimate of Change in Reenlistments Under an Alternative System

b. The key to the estimating process is the functional relationship that explains the effect that a change in compensation will have on reenlistments. All of the models define this relationship to be a type of logistic function. The intuitive appeal for the logistic curve is that it is bounded by zero and one. Therefore, the estimates of reenlistment rates must be nonnegative decimal values. The following logistic equation was used to represent the reenlistment supply function:

$$r = \frac{1}{1 + e^{-(a+b \log P)}}$$

where:

r = reenlistment rate

log = natural logarithm

P = ratio of return from staying and return from leaving ($RS \div RL$)

a,b = parameters to be estimated.

The elasticity (E) of r with respect to P can be derived for this supply function as:

$$E = (1-r)\ b$$

where:

E is an estimate of reenlistment elasticity or the change in reenlistment rates that is produced by a percent change in compensation.

c. Using this elasticity function, the change in the current system reenlistment rates (Δr_c) can be estimated for a percentage change in the ratio P as follows:

$$\Delta r_c = b(1-r_c)\ r_c \frac{\Delta P}{P}$$

where

b,P are as previously defined.

Therefore, the reenlistment rates under an alternative retirement system (r_A) are simply:

$$r_A = r_c + \Delta r_c.$$

According to the Chipman paper, the AF model developers did not estimate the "b" parameter from empirical data. Rather, the "b" values that were used to solve the elasticity function were attributed to an analysis of first termers.[2]

2-6. ESTIMATE OF OVERALL CONTINUATION RATES UNDER AN ALTERNATIVE SYSTEM

a. As indicated in Figure 2-5, the model uses simulated force profiles and the estimated reenlistment rates for the alternative system to compute overall continuation rates for the proposed system. Overall continuation rates are estimated from the following equation:

$$CR_{jk} = \left[r_{jk}(POOL_{jk}) + (S_{jk})(POOL_{j+1,k}) + \sum_{t=j+2}^{j+3} POOL_{t,j} \right] + \sum_{t=j}^{j+3} POOL_{t,k}$$

where:

CR_{jk} = estimate of the overall continuation rate for YOS j and grade k

r_{jk} = estimated reenlistment rate for the alternative (from paragaraph 2-5)

$POOL_{jk}$ = personnel in pay grade k who face reenlistment decision in YOS j

S_{jk} = Continuation rate (1-attrition rate) for non-ETS groups in YOS j and grade k.

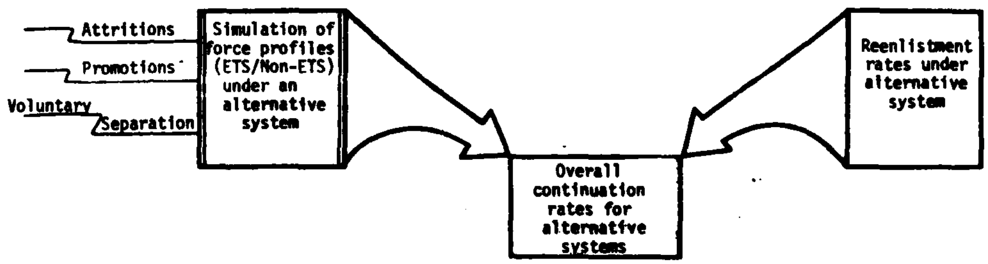


Figure 2-5. Overall Continuation Rates Under an Alternative System

b. The model developers assumed that under an alternative system, the yearly distribution of individuals facing an ETS would change from that of the current system as members adjust enlistment contracts to game the new system in an optimal fashion. For example, the PCMC proposal permits vesting of retirement benefits and trust fund credits after 10 years of service. To simulate the change in the distribution of individuals (POOLS) facing ETS each year under a new system, the model "ages" personnel within each year of a 4-year enlistment cycle. Non-ETS continuation patterns and promotional probabilities are assumed to be independent of retirement systems. This aging process starts with an initial force and updates the distribution of personnel by grade and POOLS for each subsequent year under an alternative system. Table 2-1 illustrates the aging process for pay grades E4 and E5. As shown in the table, the starting force begins in the 5th continuation year (first termers excluded), and it consists of 41,000 E4s (total for Column 2a) and 59,000 E5s (total for Column 3a). Of the starting E4 population, 9,000 are scheduled to complete their enlistment

obligation in the 5th year, 2,000 in the 6th year, 12,000 in the 7th year, and 18,000 in the 8th year. Column 2b shows how this 5th year force is aged to simulate the new 6th year force of E4s. Notice that 33,066 of the 41,000 E4s who started in the 5th year are still around for the 6th year. The variance represents voluntary separations, attritions, and promotions to grade E5. Columns 3a and 3b show the E5 profile for the 5th year and the 6th year, respectively.

Table 2-1. Simulation of E4 and E5 Force Profiles in the Fifth and Sixth Year of Service

Column 1	Column 2		Column 3	
	E4		E5	
Force distribution by year (i=5)	(a) YOS 5	(b) YOS 6	(a) YOS 5	(b) YOS 6
POOL(i)	9,000	1,848	19,000	3,160
POOL(i+1)	2,000	11,086	4,000	15,201
POOL(i+2)	12,000	16,628	19,000	21,673
POOL(i+3)	18,000	3,504	27,000	3,588
Total	41,000	33,066	59,000	43,622

2-7. MODEL OUTPUT. Table 2-2 presents an example of model output. This output compares reenlistment rates and earning streams for an E7 under the PCMC alternative using the methodology of the Air Force model. The reenlistment rates for an E7 under the current system are shown in Column 2. Column 3 presents the reenlistment rates that are predicted for the PCMC proposal. The impact of the PCMC in terms of predicted changes in reenlistments and the predictions of overall continuation rates are shown in Columns 4 and 5, respectively. Columns 6 and 7 present the dollar return associated with a decision to stay in the military under the current system and the PCMC, respectively. In Column 8, the change in return from staying is presented. Columns 9 and 10 present similar information for the decision to leave the service. The dollar return for leaving under the PCMC can be computed by summing Columns 9 and 10.

Table 2-2. Output for Grade E-7 Using the PCMC Alternative and the AF Model's Lifetime Earnings Methodology

(1) Years of service	(2) Original reenlistment rates	(3) Estimated reenlistment rates	(4) Change in rates	(5) Overall continuation rates	(6) RS	(7) ARS	(8) ΔRS	(9) RL	(10) ΔRL
9	1.0000	.9767	.0233	NA	$262,294	$268,108	$5,815	$252,834	$0
10	.6250	.6554	.0304	.9423	274,861	281,457	6,595	259,910	0
11	.8000	.7929	-.0071	.9675	290,174	297,627	7,453	266,777	8,792
12	.9583	.9475	-.0108	.9724	302,134	306,042	3,908	273,379	7,591
13	.9730	.9636	-.0094	.9769	312,104	315,047	2,944	279,655	9,089
14	.9333	.9189	-.0144	.9829	324,180	325,844	1,664	285,535	10,637
15	.9750	.9662	-.0088	.9886	336,055	336,591	535	290,940	12,391
16	.9798	.9728	-.0070	.9854	347,355	346,274	-1,081	295,916	14,093
17	.9955	.9906	-.0049	.9931	356,627	353,434	-3,194	300,971	15,957
18	.9964	.9852	-.0112	.9934	366,815	360,891	-5,924	305,567	18,055
19	.9919	.9855	-.0064	.9952	376,482	366,858	-9,624	309,591	20,634
20	.9906	.9839	-.0067	.9912	385,772	371,324	-14,447	312,979	23,325
21	.6190	.7591	.1401	.7591	397,191	381,789	-15,402	386,352	-42,646
22	.6910	.8305	.1395	.8305	407,206	387,355	-19,850	393,001	-44,750
23	.7180	.8564	.1384	.8564	414,509	390,027	-24,482	404,477	-51,048
24	.7550	.8241	.0691	.8241	418,539	390,418	-28,121	410,407	-52,123
25	.8070	.8688	.0618	.8688	419,669	386,680	-32,988	415,753	-52,839
26	.8580	.8967	.0387	.8967	420,261	382,708	-37,553	420,031	-53,437

Legend:

RS = Return for staying in military service under the present retirement system.

ARS = Return for staying in military service under an alternative system.

ΔRS = Change in return for staying in military relative to the present system or RS-ARS.

RL = Return for leaving military service under the present retirement system.

ΔRL = Change in return for leaving military service relative to the present system (RL-ARL), where ARL is the return for leaving military service under an alternative system. Values for ARL are omitted from the table but can be derived as ARL = RL + ΔRL.

2-8. LIMITATIONS. Some features of the AF model that might limit its usefulness are:

a. The program for the Air Force model was designed to include two methodologies, the USAF lifetime earnings method as discussed above and an income maximizing method that was developed by Dr. Warner (CNA) for OSD.[3] Each of these methods was to be used to evaluate three different alternative retirement systems, namely, proposals by the PCMC, the OSD, and the USAF. According to the developer, however, the program has been tested completely on the lifetime earnings method only. In addition, the sample run provided CAA for benchmarking addressed the PCMC alternative only. Therefore, it is not known whether the income maximizing method can be used. Nor is it known how successfully the lifetime earnings method can be used to evaluate alternatives other than the PCMC.

b. The program code (Appendix D) is nonmodular and virtually free of comments. This makes the model difficult to understand, and it degrades the capability to make changes to the model.

c. The AF model, like all of the current models that were reviewed, does not address the impact of the PCMC proposal for medical, PX, and commissary benefits.

d. The model assumes that the members of the population being analyzed are knowledgeable of, and will apply, economic techniques to calculate their economic benefits under alternative systems and that they will base their decision solely on economic considerations.

CHAPTER 3

COMPARATIVE ANALYSIS OF THE AF MODEL USING USAF VERSUS ARMY DATA

3-1. GENERAL. This chapter describes the analysis that compared the results of using the AF model with Army input data to the results using AF input data. In this analysis, Army reenlistment trends were estimated for the PCMC proposal. These trends were then compared to trends predicted for the Air Force under the PCMC. The chapter also documents the method used by ODCSPER to compute the Army reenlistment rates that were provided to CAA. As will be discussed in paragraph 3-5, the ODCSPER method provided the same reenlistment rate for careerists in pay grades E6-E9 with from 8 to 19 years of service.

3-2. ARMY DATA SOURCE. The Enlisted Division of ODCSPER provided Army data for the model parameters shown in Figure 2-2 with a "U." This data was considered adequate for testing the converted AF model, but would require additional refinement for production runs.

3-3. COMPARATIVE TEST. The AF model was tested with this tentative data, and the results from this test run were compared to results of a run using all AF data. Both runs evaluated the retirement system proposed by the President's Commission on Military Compensation (PCMC). The PCMC proposal offers monetary retirement returns after the tenth year of service and is contrary to the current retirement system in which no benefits are received prior to completing 20 years of service.

3-4. TEST RESULT. Figures 3-1 through 3-6 present, in the upper left graphs, the reenlistment rates for Air Force and Army enlisted personnel under the present retirement system. These data were inputs to the model. Reenlistment rates are defined as the proportion of reenlistments to the total eligible to reenlist. The graphs in lower right show the change, or delta, relative to present system rates that were estimated for the PCMC alternative. The same general pattern of changes in reenlistment trends could be observed for the PCMC using both Army and Air Force data. Because the PCMC offers retirement benefits after 10 years of service, reenlistment rates increased (positive delta) during the 5-10 YOS and the 21-30 YOS intervals, but they generally decreased (negative delta) during the 11-20 YOS interval.

3-5. VARIABILITY IN REENLISTMENT RATE INPUTS. Reenlistment rates for the Army were generally lower than the Air Force rates. This was especially true in the 10-19 YOS interval. The lower Army rates result, at least in part, from the method used to compute

them. ODCSPER used the Automatic Interaction Detector (AID) Model to calculate Army reenlistment rates. Figure 3-7 presents an AID tree with the reenlistment rates that were computed for individuals with at least 4 YOS. The AID Model identified a sample of 20,785 individuals with four or more YOS who had either reenlisted or extended within one year of their ETS date. For this group the single best predictor of reenlistment was total active years of service. The greatest difference in reenlistment behavior occurred at the 7th year point. Approximately 69 percent of eligible personnel with more than 7 years of service reenlisted, while the eligible pool with 7 or less years exhibited a 42 percent rate. This later group also differed significantly in propensity to reenlist based on whether they had completed 8-19 years or over 19 years. Finally, these two groups (8-19 and 19+) split into terminal cells with pay grade as a significant predictor of reenlistments. The reenlistment rates of these terminal cells were provided as input to represent Army reenlistment trends. For example, a reenlistment rate of 0.8334 was used to represent individuals in grades E6-E9 who have completed anywhere from 8 to 19 years of service. It is recognized that a terminal cell for the AID Model indicates that no further significant differences were noted for the sample group at a specified significance level (in this case, 0.2 percent). However, it is difficult to believe that under the current retirement system, which offers significant benefits to those who complete 20 years of service, reenlistment behavior would not differ significantly between individuals with 8 years and those with 17, 18, or 19 years. Therefore, the validity of this input data must be a primary focus of any future analysis.

3-6. SUMMARY OF ANALYSIS. The same type of behavior was observed in Army and Air Force reenlistment trends under the PCMC. However, Army rates are generally lower than Air Force rates. This is a function of Army input rates for the current retirement system. An analysis of Army input data raised questions as to the validity of using a single reenlistment rate for an individual with anywhere from 8 to 19 years of service. Future analysis should focus on improving the validity of this input data.

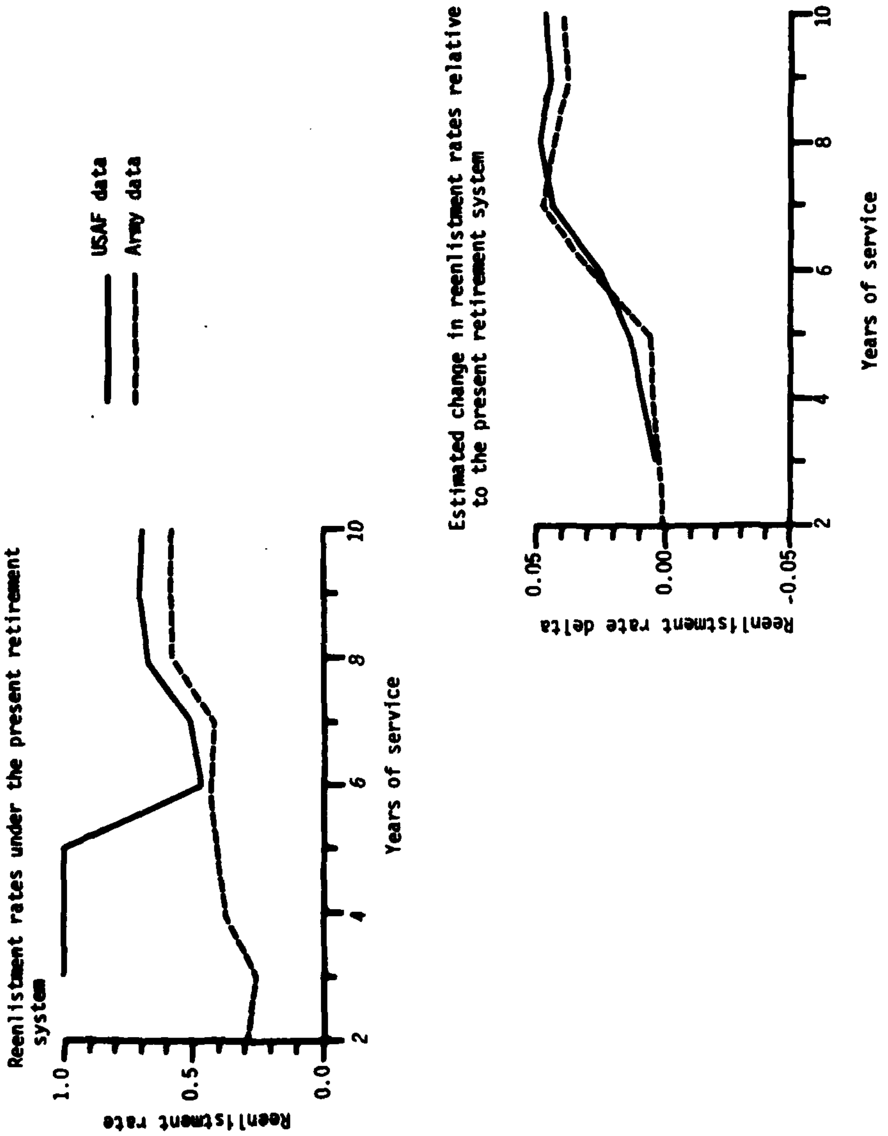


Figure 3-1. Comparison of Retention Trends for E4 Using USAF vs Army Data

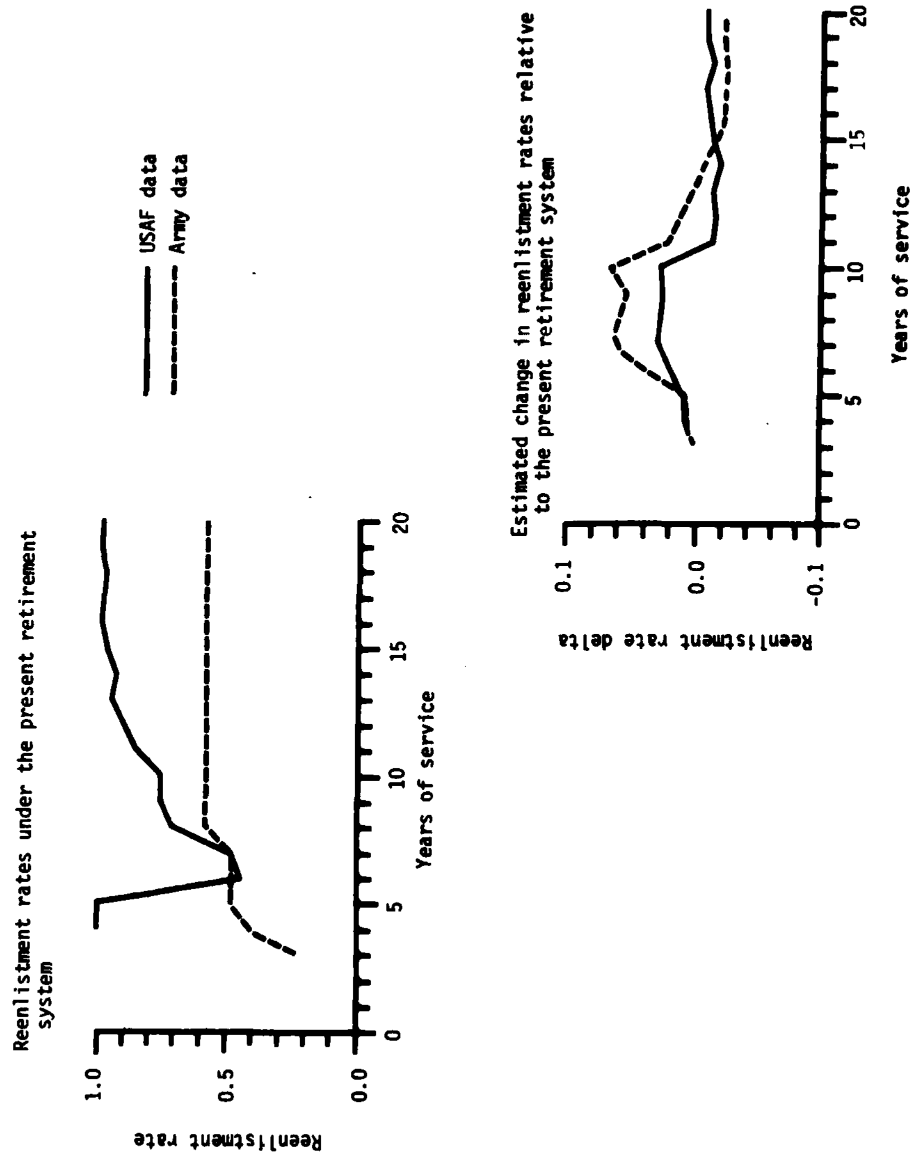


Figure 3-2. Comparison of Retention Trends for E5 Using USAF vs Army Data

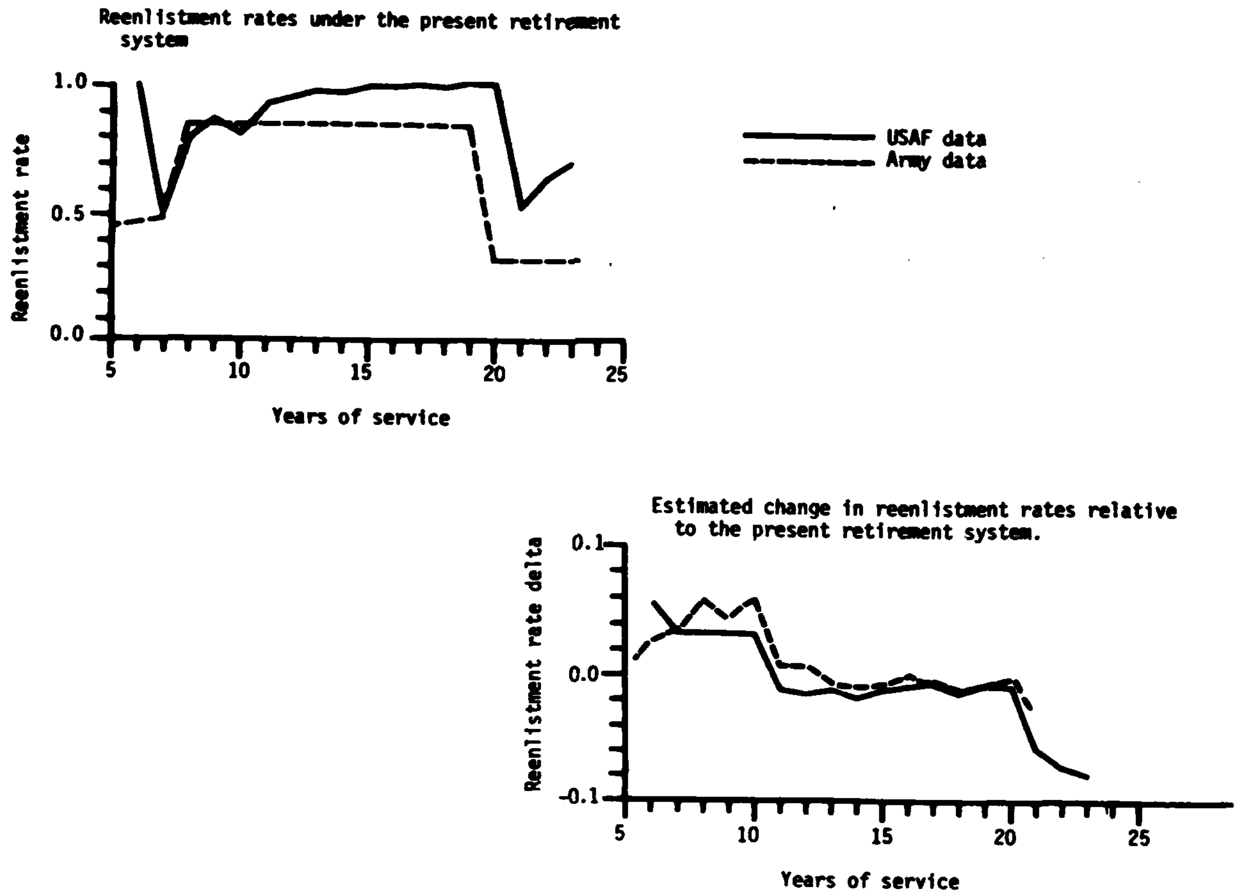


Figure 3-3. Comparison of Retention Trends for E6 Using USAF vs Army Data

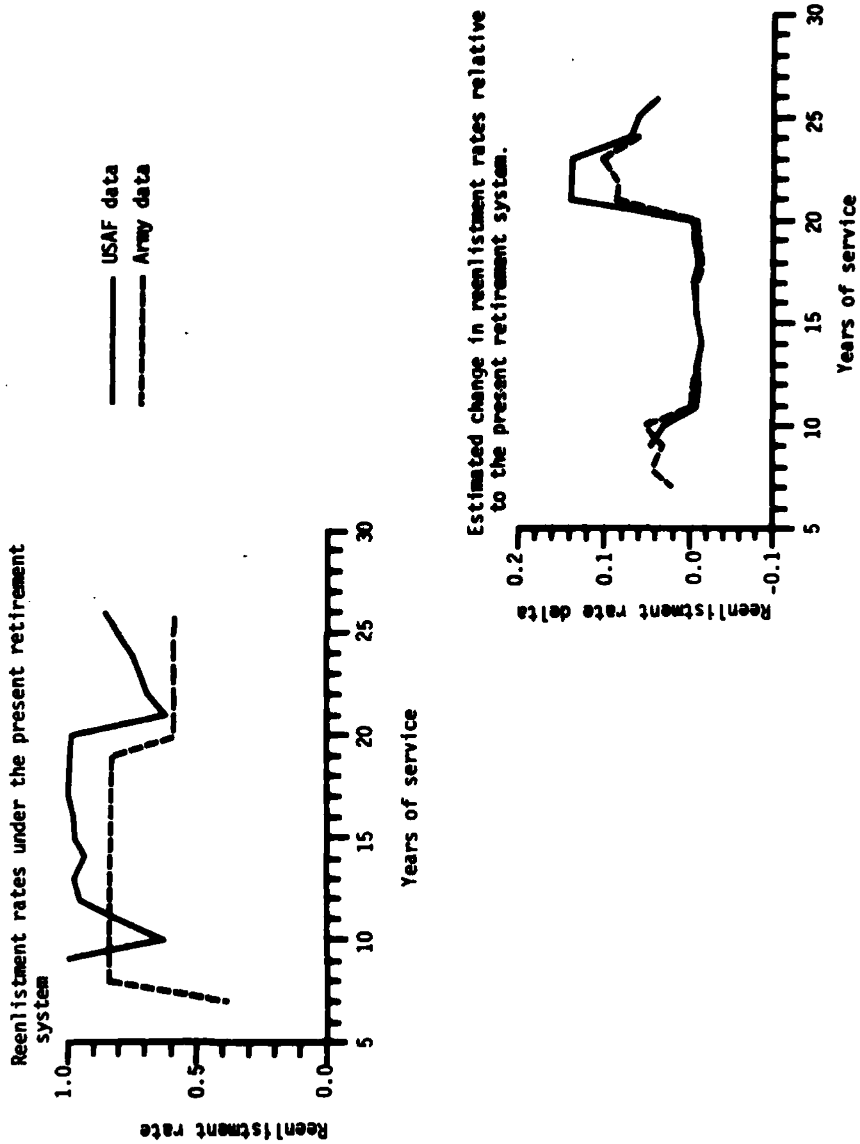


Figure 3-4. Comparison of Retention Trends for E7 Using USAF vs Army Data

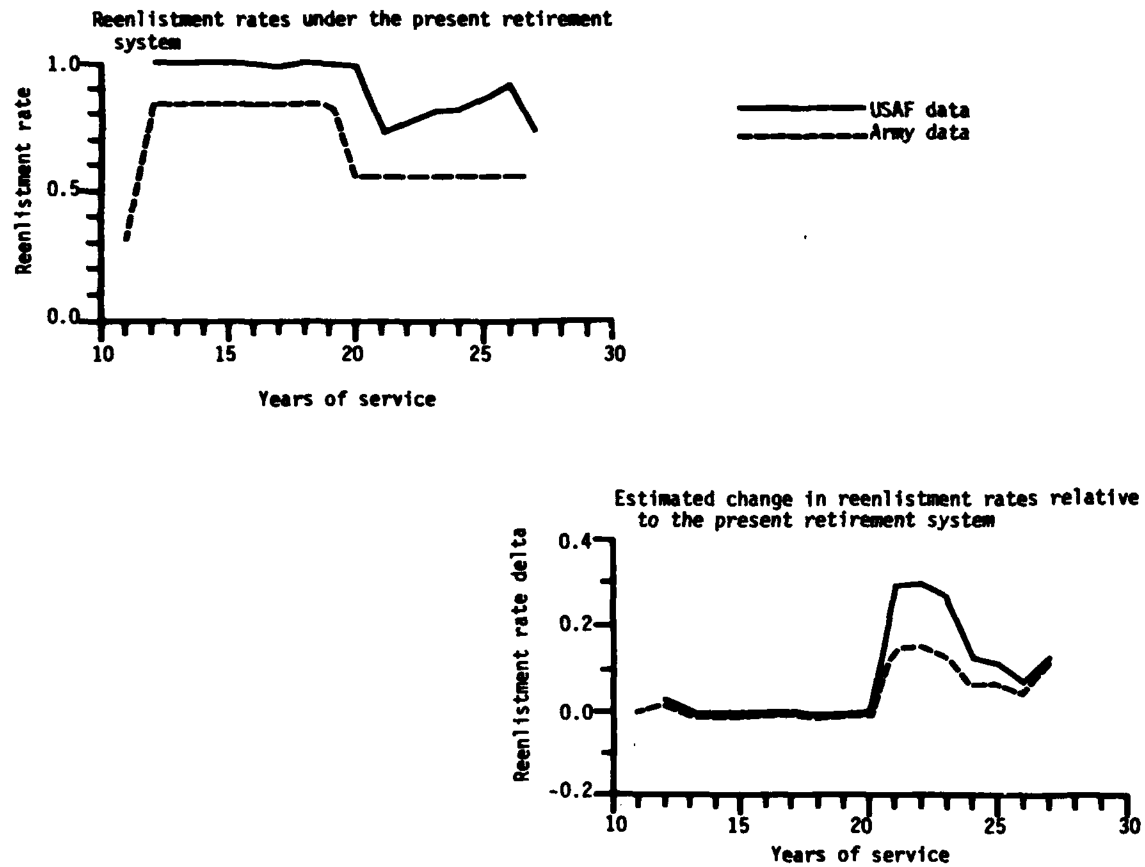


Figure 3-5. Comparison of Retention Trends for E8 Using USAF vs Army Data

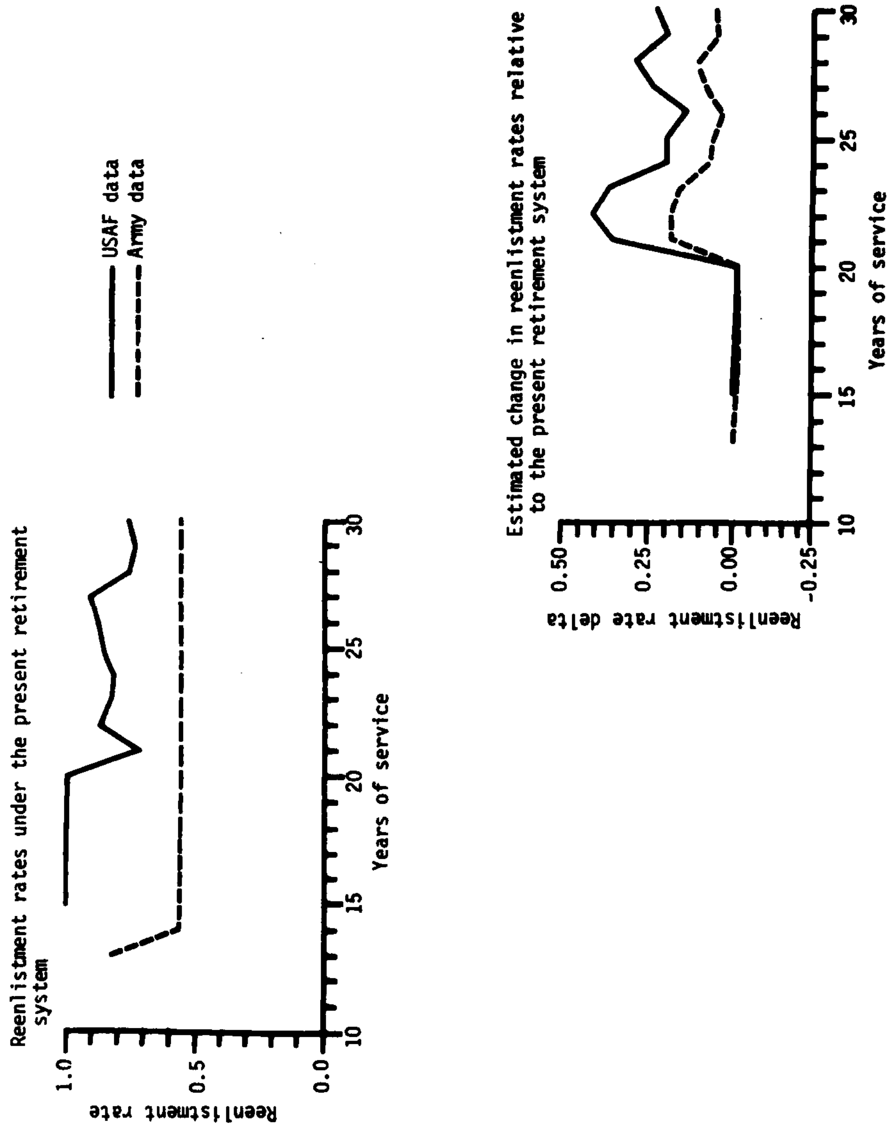


Figure 3-6. Comparison of Retention Trends for E9 Using USAF vs Army Data

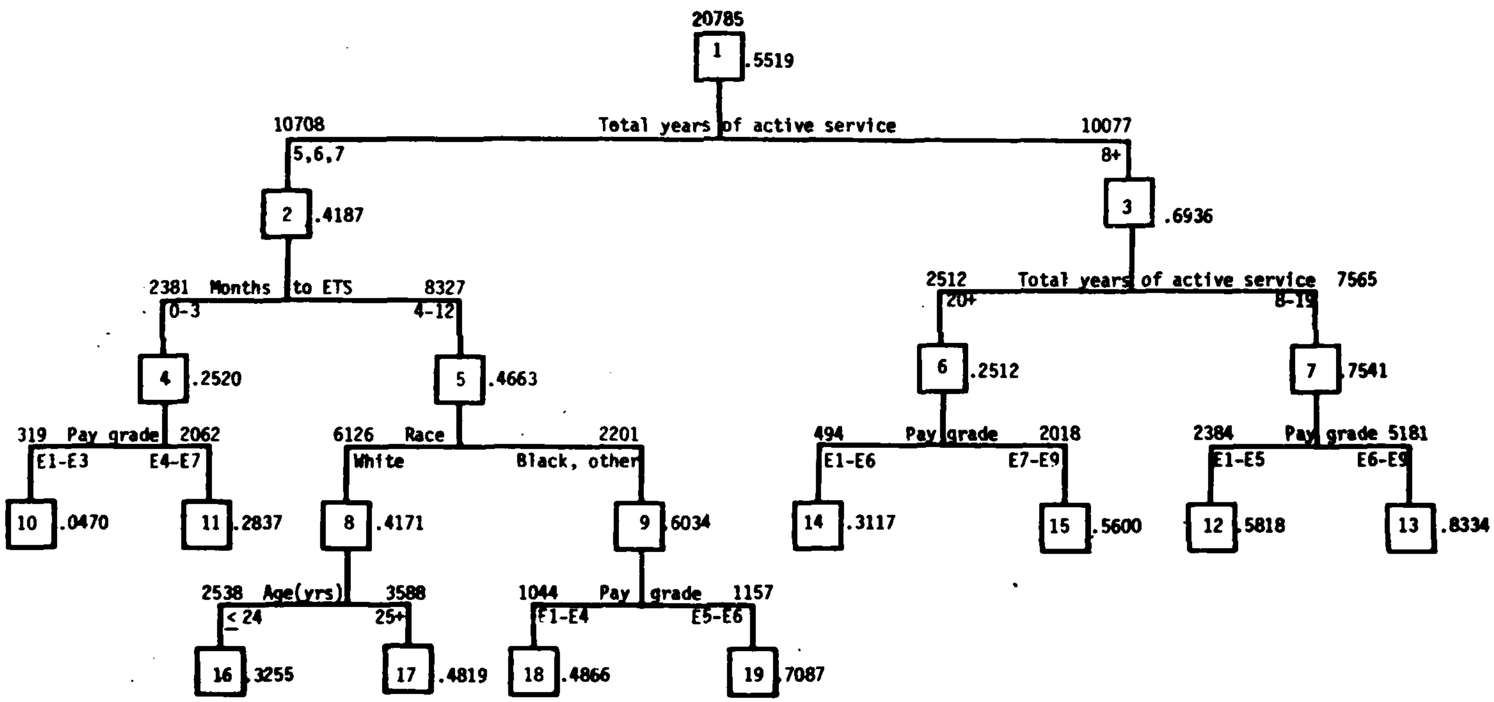


Figure 3-7. AID-E Analysis to Compute Reenlistment Rates for Personnel with more than 4 Years of Active Service

APPENDIX A

PROJECT CONTRIBUTORS

1. PROJECT TEAM

   a. Team Members

   Ms Ola Berry, Methodology, Resources and Computation Directorate
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   MAJ John Johnson

   b. Other Contributors

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   c. Support Personnel

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   CPT James Hoskins, Directorate of Personnel Plans, USAF/MP
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APPENDIX B

REFERENCES AND BIBLIOGRAPHY

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1. US Navy Personnel Research and Development Center, Comparative Analysis of Enlisted Retirement Behavior Models (DRAFT Report by Mark Chipman), San Diego, CA, July 1979.

2. Office, Secretary of Defense, Predicting Changes in Enlisted Retention for Alternative Retirement Systems, Washington, DC, July 1978.

3. Center for Naval Analyses, Analysis of the Retention Impact of the Proposed Retirement System, Warner, John T., Alexandria, VA, March 1978.

BIBLIOGRAPHY

Meeting between CPT James Hoskins, US Air Force and Ms Ola Berry and Mr. Jerry Thomas, CAA, subject: Air Force Personnel Retention Model, 27 July 1979.

Meeting between Dr. John Warner, Center for Naval Analysis (CNA) and Mr. Leonard Freeman, Mr. Jerry Thomas and Ms Ola Berry, CAA, subject: OSD Personnel Retention Model, 9 August 1979.

Report of the President's Commission on Military Compensation, Washington, DC, April 1978.

APPENDIX C

INPUTS REQUIRED BY PERSONNEL RETENTION MODEL (DATA SHOULD BE AS OF END OF FY 78)

Section I. PERSONNEL DATA

C-1. Promotion probabilities for grades E4 through E9 for 30 years, i.e.,

YOSC	E4	E5	E6	E7	E8	E9
1	$X_{1,4}$	..	..	..	$X_{1,8}$	..
2	$X_{2,4}$					
.	.					
.	.					
.	.					
.	.					
.	.					
.	.					
.	.					
30	$X_{30,4}$	..$X_{30,5}$				

X_{kij} for i = 1,30; j = 4,9 where X_{ij} is probability of being promoted to grade j in year of service i.

C-2. Reenlistment rates for ETS eligibles for grades E4 through E9, for year of service 0-30.

C-3. Continuation rates for non-ETS eligibles for grades E4 through E9 for years of service 0-30.

C-4. Continuation rates for years 21-30 for grades E4 through E9. These rates are for all personnel regardless of ETS eligibility. Rates are by grade and into year.

C-5. For grades E4 through E9, the year of service requirement for:

a. First year of promotion to grade.

b. High year of tenure for grade.

c. Last year of promotion eligibility.

C-6. Fifth year population pools by grade and years of service. This would be a distribution of a pool by grade that would face the reenlistment decision in years 5, 6, 7, and 8.

C-7. Survival rates (mortality rates) for ages 19-64 (inclusive). (Note: To allow for expansion of model, rates should cover average age at entry (enlisted) to age at death; maybe 19-75?

C-8. Average age at entry for EM and officer.

C-9. Average age at death (life expectancy).

C-10. Reenlistment elasticities by year of service. The values indicate the changes in the reenlistment rate produced by a 1 percent change in cost of leaving/staying in military service.

C-11. Percent of personnel reaching ETS/reenlistment decision by year of service and grade (by grade is desired but optional).

C-12. Enlisted force distribution by year of service and grade at end of FY 78.

C-13. Enlisted force distribution by year of service and grade for objective force.

Section II. ECONOMIC DATA

C-14. Personal discount rates by year, with year 1 being present year, for 57 years.

C-15. RMC by year of service and grades E4 through E9.

C-16. Present value for retirement pay under current system.

C-15. Present value for retirement pay under alternative systems.

APPENDIX D

SOURCE PROGRAM CODE FOR THE AIR FORCE MODEL

```
@ED,R Q2RENT.ARMY
READ-ONLY MODE
CASE UPPER ASSUMED
ED 15R2-MON-10/29/79-08:09:06-(2,)
EDIT
0:
       DIMENSION RET(31,6,2), RALT(30,6,3,2), RCLR(30,6,2), SEV(6,3)
       DIMENSION RMC(30,6,2), RS(30,6,31), RA(30,6,2), WD(30,4,3)
       DIMENSION PVC(30,6,2), DRS(30,6), DELR(30,6), BETA(30,2)
       DIMENSION RPRIME(30,6), RL(31,6), DRL(31,6), CP(46,6,2)
       DIMENSION FAC(46,2),CIVPV(46,6,2),JTAB(6,3,2),F(30,2)
       DIMENSION CONT(31,6,2),POOL(4,6,2)
C      DIMENSION ENLIST(5,7),ENLST3(25)
       DIMENSION STPOOL(4,6,2),TCONT(30,6),RETYR(10,4)
       DIMENSION PROM(6,30,2),DR(46,2),D(30,2)
       DIMENSION ARS(30,6,31),CPADJ(46,2),V(31,6,2),T(31,6,2)
       INTEGER NAME1(6),NAME2(6),ALT(3)
       DATA ALT/'PCMC','OSD ','USAF'/
       DATA NAME1/'1LT','CPT','MAJ','LTC','COL','GEN'/
       DATA NAME2/'E-4','E-5','E-6','E-7','E-8','E-9'/
C
C      DETERMINE METHOD TO BE USED:
C            1 - INCOME MAXIMIZING (WARNER)
C            2 - EXPECTED LIFETIME EARNINGS (USAF)
C
       READ(15,200) JMETH
       WRITE(16,200) JMETH
  200  FORMAT(I1)
C
C      IS RUN FOR OFFICERS OR ENLISTED ?
C            1 - OFFICERS
C            2 - ENLISTED
C
       READ(15,200) JRUN
       WRITE(16,200) JRUN
C
C      DETERMINE ALTERNATIVE TO BE PROCESSED
C
C           1 - PCMC
C           2 - OSD
C           3 - USAF
C
       READ(15,200) JALT
       WRITE(16,200) JALT
C      READ IN CPI AND PAY RAISE FACTORS
C
       READ(15,220) CPI,PR
       WRITE(16,220) CPI,PR
  220  FORMAT(2F5.3)
C
C      SELECT PRINT OPTION - I.E, DELETE PRINT OF POOLS AND/OR
C          RETENTION DATA?
C             1 - YES
C             2 - NO
C
       READ(15,251) IDELET,ISKIP
       WRITE(16,251) IDELET,ISKIP
```

```
  251 FORMAT(2I1)
C
C     SELECT PRINT OPTION WHERE:
C          1 - DELETE
C          2 - DELETE CURRENT ONLY
C          3 - PARTIAL ALT
C          4 - FULL ALT
C
      READ(15,200) JPRT
      WRITE(16,200) JPRT
C
C     READ INPUT FILE
C
C     READ IN DISCOUNT FACTORS
C
      DO 1000 I=1,46
      READ(15,1002) DR(I,1),DR(I,2)
      WRITE(16,1002) DR(I,1),DR(I,2)
 1002 FORMAT(2F5.3)
 1000 CONTINUE
C
C     READ IN PROMOTION PROBABILITIES
C
      DO 1010 IG=1,2
      DO 1008 IK=1,30
      READ(15,1012) (PROM(J,IK,IG),J=1,6)
      WRITE(16,1012) (PROM(J,IK,IG),J=1,6)
 1012 FORMAT(6F9.7)
 1008 CONTINUE
 1010 CONTINUE
C
C     READ IN REENLISTMENT RATES
C
      DO 1020 IGG=1,2
      DO 1018 IKK=1,31
      READ(15,1022) (RET(IKK,K,IGG),K=1,6)
      WRITE(16,1022) (RET(IKK,K,IGG),K=1,6)
 1022 FORMAT(6F6.4)
 1018 CONTINUE
 1020 CONTINUE
C
C     READ IN NON-ETS CONTINUATION RATES
C
      DO 1030 IKA=1,31
      READ(15,1032) (CONT(IKA,J,2),J=1,6)
      WRITE(16,1032) (CONT(IKA,J,2),J=1,6)
 1032 FORMAT(6F6.4)
 1030 CONTINUE
C
C     READ IN CONTINUATION RATES BEYOND 20 YEARS
C
      DO 1040 IKB=1,10
      READ(15,1042) (RETYR(IKB,J),J=1,4)
      WRITE(16,1042) (RETYR(IKB,J),J=1,4)
 1042 FORMAT(4F6.4)
 1040 CONTINUE
C
```

```
C       READ IN TENURE BOUNDS - 1ST YR PROM, HYT, LAST YR PROM
C
        DO 1050 IKC=1,2
        DO 1060 IGC=1,3
        READ(15,1062) (JTAB(J,IGC,IKC),J=1,6)
        WRITE(16,1062) (JTAB(J,IGC,IKC),J=1,6)
   1062 FORMAT(6I3)
   1060 CONTINUE
   1050 CONTINUE
C
C       READ IN 5TH YEAR POPULATION POOL
C
        DO 1070 IEM=1,4
        READ(15,1072) (STPOOL(IEM,JM,2),JM=1,6)
        WRITE(16,1072) (STPOOL(IEM,JM,2),JM=1,6)
   1072 FORMAT(6F7.1)
   1070 CONTINUE
C
C       READ IN MORTALITY RATES
C
        DO 1080 IM=1,46
        READ(15,1082) (FAC(IM,IC),IC=1,2)
        WRITE(16,1082) (FAC(IM,IC),IC=1,2)
   1082 FORMAT(2F6.4)
   1080 CONTINUE
C
C       READ IN ELASTICITIES  -  BETA VALUES
C
        DO 1090 IJ=1,30
        READ(15,1092) (BETA(IJ,JI),JI=1,2)
        WRITE(16,1092) (BETA(IJ,JI),JI=1,2)
   1092 FORMAT(2F5.3)
   1090 CONTINUE
C
C       READ IN CIVILIAN PAY
C
        DO 1100 IR=1,46
        READ(15,1102) (CP(IR,1,IGR),IGR=1,2)
        WRITE(16,1102) (CP(IR,1,IGR),IGR=1,2)
   1102 FORMAT(2F7.1)
   1100 CONTINUE
C
C       READ IN MILITARY PAY  -  I.E., RMC
C
        DO 1130 IRM=1,2
        DO 1120 IRC=1,30
        READ(15,1122) (RMC(IRC,JM,IRM),JM=1,6)
        WRITE(16,1122) (RMC(IRC,JM,IRM),JM=1,6)
   1122 FORMAT(6F7.1)
   1120 CONTINUE
   1130 CONTINUE
C
C       READ IN CURRENT RETIREMENT PAY
C
        DO 1150 IRG=1,2
        DO 1140 ICS=1,30
        READ(15,1142) (RCUR(ICS,JC,IRG),JC=1,6)
```

```
      WRITE(16,1142) (RCUR(ICS,JC,IRG),JC=1,6)
 1142 FORMAT(6F8.1)
 1140 CONTINUE
 1150 CONTINUE
C
C     READ IN WITHDRAWALS FROM RALT
C
      DO 1160 IY=1,30
      READ(15,1162) (RA(IY,IG,1),IG=1,6)
      WRITE(16,1162) (RA(IY,IG,1),IG=1,6)
 1162 FORMAT(6F7.1)
 1160 CONTINUE
C
C     READ IN WITHDRAWALS FROM FUND
C
      DO 1170 IWD=1,30
      READ(15,1172) (WD(IWD,IGD,1),IGD=1,6)
      WRITE(16,1172) (WD(IWD,IGD,1),IGD=1,6)
 1172 FORMAT(6F7.1)
 1170 CONTINUE
C
C     READ IN ALTERNATIVE SYSTEMS
C
      DO 1200 IAL=1,2
      DO 1190 IALT=1,3
      DO 1180 IYA=1,30
      READ(15,1182) (RALT(IYA,JAL,IALT,IAL),JAL=1,6)
      WRITE(16,1182) (RALT(IYA,JAL,IALT,IAL),JAL=1,6)
 1182 FORMAT(6F8.1)
 1180 CONTINUE
 1190 CONTINUE
 1200 CONTINUE
      DO 10 J=1,5
      DO 10 I=1,31
      CONT(I,J,2) = CONT(I,6,2)
   10 CONTINUE
      DO 80 JG=1,6
      DO 1901 JYY=1,30
      RCUR(JYY,JG,2) = RCUR(JYY,JG,2) * 1.1
      RALT(JYY,JG,1,2) = RALT(JYY,JG,1,2) * 1.1 - RA(JYY,JG,1)
      RALT(JYY,JG,2,2) = RALT(JYY,JG,2,2) * 1.1
      RALT(JYY,JG,3,2) = RALT(JYY,JG,3,2) * 1.1
 1901 CONTINUE
      DO 82 JYY=1,31
      DO 84 JY=1,30
      RL(JYY,JG) = 0.0
      DRL(JYY,JG) = 0.0
      V(JYY,JG,1) = 0.0
      V(JYY,JG,2) = 0.0
      TCONT(JY,JG) = 0.0
      RS(JY,JG,JYY) = 0.0
      T(JYY,JG,1) = 0.0
      T(JYY,JG,2) = 0.0
      ARS(JY,JG,JYY) = 0.0
      DRS(JY,JG) = 0.0
      DELR(JY,JG) = 0.0
      RPRIME(JY,JG) = 0.0
```

```
   84 CONTINUE
   82 CONTINUE
   80 CONTINUE
      DO 2032 JY=1,46
      DO 2032 JR=1,2
      CPADJ(JY,JR) = 0.0
 2032 CONTINUE
      DO 86 IP=1,4
      DO 86 JG=1,6
      PCOL(IP,JG,1) = 0.0
      PCOL(IP,JG,2) = 0.0
   86 CONTINUE
      IF(JALT.GT.3.OR.JRUN.NE.2) GO TO 2209
      DO 2208 IYR=1,10
      DO 2208 JGR=1,4
      IYR2 = IYR + 20
      JGF  = JGR + 2
      RET  YR2,JGF2,JRUN) = RETYR(IYR,JGR)
 2208 CONTINUE
 2209 CONTINUE
      A = (1.0 + PR) / (1.0 + CPI)
      DO 2691 MY=1,30
      DO 2691 MG=1,6
      DO 2691 MR=1,2
      RMC(MY,MG,MR) = RMC(MY,MG,MR) * (A ** MY)
 2691 CONTINUE
      IF(JALT.LT.2) GO TO 2700
      DO 2600 JGR=1,6
      SEV(JGR,JALT) = 0.0
      DO 2600 JYY=1,30
      AD(JYY,JGR,JALT) = 0.0
 2600 CONTINUE
 2700 CONTINUE
      SEV(1,1) = 599.40 * 2.5 * (A**10)
      SEV(2,1) = 721.80 * 7.5 * (A**20)
      SEV(3,1) = 850.20 * 9.0 * (A**23)
      SEV(4,1) = 1159.80 * 10.5 * (A**26)
      SEV(5,1) = 1289.40 * 11.5 * (A**28)
      SEV(6,1) = 0.0
      DO 76 JJ=1,30
      KK = JJ
      IF(JRUN.EQ.1) KK=JJ+4
      F(JJ,JRUN) = FAC(KK,JRUN)
      D(JJ,JRUN) = (1.0 + CPI) / (1.0 + DR(KK,JRUN))
   76 CONTINUE
      DO 2751 MYR=1,46
      MM = MYR
      IF(JRUN.EQ.1) MM=MYR-4
      CPADJ(MYR,JRUN) = CP(MYR,1,JRUN) * (A ** MM)
 2751 CONTINUE
      CIVPV(46,1,JRUN) = CPADJ(46,JRUN) * FAC(46,JRUN)
      DO 622 JCM=1,45
      JCA = 46 -JCM
      DU = (1.0 + CPI) / (1.0 + DR(JCA,JRUN))
      CV = CIVPV(46,1,JRUN)
      DO 62 J=1,JCM
      JY = 46-J
```

```
      CV = FAC(JY,JRUN) * (CPADJ(JY,JRUN) + DD * CV)
   62 CONTINUE
      CIVPV(JCW,1,JRUN) = CV
  622 CONTINUE
      DO 63 J=1,46
      DO 63 JJ=2,6
      CIVPV(J,JJ,JRUN) = CIVPV(J,1,JRUN)
   63 CONTINUE
      DO 307 J=20,24
      DO 307 JJ=3,4
      CIVPV(J,JJ,1) = CIVPV(J,1,1) * 1.0
  307 CONTINUE
      DO 311 J=25,46
      CIVPV(J,5,1) = CIVPV(J,1,1) * 1.0
      DO 311 JJ=3,4
      CIVPV(J,JJ,1) = CIVPV(J,1,1) * 1.0
  311 CONTINUE
      DO 3307 J=16,20
      DO 3307 JJ=1,5
      CIVPV(J,JJ,2) = CIVPV(J,1,2) * 1.0
 3307 CONTINUE
      DO 3311 J=21,46
      DO 3311 JJ=1,4
      CIVPV(J,JJ,2) = CIVPV(J,JJ,2) * 1.0
 3311 CONTINUE
      DO 3312 J=21,46
      DO 3312 JJ=5,6
      CIVPV(J,JJ,2) = CIVPV(J,JJ,2) * 1.0
 3312 CONTINUE
      DO 37 JG=1,6
      DO 37 JY=1,30
      JYR = JY + 1
      IF(JRUN.EQ.1) JYR=JY+5
      PVC(JY,JG,JRUN) = CIVPV(JYR,JG,JRUN)
   37 CONTINUE
      JLOWR = 1
      JUPPR = 6
      IF(JRUN.EQ.1) JLOWR = 2
      IF(JRUN.EQ.1) JUPPR = 5
      DO 38 K=1,2
      DO 38 J=2,6
      JJ = JTAB(J,1,JRUN) - 1
      PVC(JJ,J,K) = PVC(JJ,J-1,K)
   38 CONTINUE
      IF(IDELFT.EQ.1) GO TO 2063
      WRITE(6,205)
  205 FORMAT(1H1,1X,'DECISION',5X,'CONTINUATION',3X,' GRADE ',3X,
     * ' GRADE ',3X,' GRADE ',3X,' GRADE ',3X,' GRADE ',,3X,' GRADE ')
      WRITE(6,206)
  206 FORMAT(4X,'YEAR',11X,'YEAR',10X,'E4',8X,'E5',8X,'E6',8X,
     * 'E7',8X,'E8',8X,'E9')
 2063 CONTINUE
      DO 710 JY=1,30
      DO 710 JG=1,6
      RL(JY+1,JG) = RCUR(JY,JG,JRUN) + PVC(JY,JG,JRUN)
      DRL(JY+1,JG) = RALT(JY,JG,JALT,JRUN) - RCUR(JY,JG,JRUN)
      IF(JY.EQ.JTAB(JG,2,JRUN)) DRL(JY+1,JG)=DRL(JY+1,JG)+SEV(JG,JALT)
```

```
  710 CONTINUE
      IF(JMETH.EQ.1) GO TO 801
      DO 715 JGM=JLOWR,JUPPR
      JGR=7-JGM
      JLO=JTAB(JGR,1,JRUN)
      JHI=JTAB(JGR,2,JRUN)
      JNUM = 0
      JLOW = JTAB(1,1,JRUN)
      DO 751 JYR=JLOW,JHI
      JJ = JHI - JNUM
      IJNUM = 0
      DO 752 IJYR=JJ,JHI
      KJ = JHI - IJNUM
      IF(KJ.LT.JLO) GO TO 7520
      IF(KJ.NE.JHI) GO TO 753
      V(KJ+1,JGR,JRUN) = .02
      RS(JJ,JGR,KJ+1) = 0.
      T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR)
      ARS(JJ,JGR,KJ+1) = 0.
      GO TO 755
  753 CONTINUE
C*    IF(KJ.NE.JJ+3.AND.KJ.NE.JJ+7.AND.KJ.NE.JJ+11.AND.KJ.NE.JJ+15
C*   * .AND.KJ.NE.JJ+19.AND.KJ.NE.JJ+23.AND.KJ.NE.JJ+27) GO TO 754
      IF(KJ.NE.JJ+3) GO TO 882
      GO TO 899
  882 IF(KJ.NE.JJ+7) GO TO 884
      GO TO 899
  884 IF(KJ.NE.JJ+11) GO TO 886
      GO TO 899
  886 IF(KJ.NE.JJ+15) GO TO 888
      GO TO 899
  888 IF(KJ.NE.JJ+19) GO TO 891
      GO TO 899
  891 IF(KJ.NE.JJ+23) GO TO 892
      GO TO 899
  892 IF(KJ.NE.JJ+27) GO TO 754
  899 V(KJ+1,JGR,JRUN) = RET(KJ+1,JGR,JRUN)
      T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR)
      GO TO 755
  754 CONTINUE
      V(KJ+1,JGR,JRUN) = CONT(KJ+1,JGR,JRUN)
      T(KJ+1,JGR,JRUN) = 0.0
      IF(KJ+1.LE.20.OR.JALT.GT.3) GO TO 755
      V(KJ+1,JGR,JRUN) = RET(KJ+1,JGR,JRUN)
      T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR)
  755 CONTINUE
      IF(JGR.NE.6) GO TO 756
      RS(JJ,JGR,KJ) = RS(JJ,JGR,KJ+1) * V(KJ+1,JGR,JRUN) * D(KJ,JRUN) +
     * RMC(KJ,JGR,JRUN) * D(KJ,JRUN) * (1.-V(KJ+1,JGR,JRUN)) *
     * T(KJ+1,JGR,JRUN)
      GO TO 757
  756 CONTINUE
      RS(JJ,JGR,KJ) = (RS(JJ,JGR,KJ+1) * V(KJ+1,JGR,JRUN) * D(KJ,JRUN) +
     1 RMC(KJ,JGR,JRUN) * D(KJ,JRUN) * (1.-V(KJ+1,JGR,JRUN)) *
     2 T(KJ+1,JGR,JRUN)) * (1.-PROM(JGR+1,KJ,JRUN)) +
     3 PROM(JGR+1,KJ,JRUN) * RS(JJ,JGR+1,KJ)
  757 CONTINUE
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```
7520 IJNUM = IJNUM+1
 752 CONTINUE
     IJNUM = 0
     DO 758 IJYR = JJ,JHI
     KJ = JHI-IJNUM
     IF(KJ.LT.JLO) GO TO 7580
     IF(KJ.NE.JHI) GO TO 760
     T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR) + DRL(KJ+1,JGR)
     GO TO 3376
 760 CONTINUE
C*   IF(KJ.NE.JJ+3.AND.KJ.NE.JJ+7.AND.KJ.NE.JJ+11.AND.KJ.NE.JJ+15
C*   * .AND.KJ.NE.JJ+19.AND.KJ.NE.JJ+23.AND.KJ.NE.JJ+27) GO TO 759
     IF(KJ.NE.JJ+3) GO TO 1882
     GO TO 1899
1882 IF(KJ.NE.JJ+7) GO TO 1884
     GO TO 1899
1884 IF(KJ.NE.JJ+11) GO TO 1886
     GO TO 1899
1886 IF(KJ.NE.JJ+15) GO TO 1888
     GO TO 1899
1888 IF(KJ.NE.JJ+19) GO TO 1891
     GO TO 1899
1891 IF(KJ.NE.JJ+23) GO TO 1892
     GO TO 1899
1892 IF(KJ.NE.JJ+27) GO TO 759
1899 V(KJ+1,JGR,JRUN) = RPRIME(KJ+1,JGR)
     T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR) + DRL(KJ+1,JGR)
 759 CONTINUE
     IF(KJ+1.LE.20.OR.JALT.GT.3) GO TO 3376
     V(KJ+1,JGR,JRUN) = RPRIME(KJ+1,JGR)
     T(KJ+1,JGR,JRUN) = RL(KJ+1,JGR) + DRL(KJ+1,JGR)
3376 CONTINUE
     IF(JGR.NE.6) GO TO 761
     ARS(JJ,JGR,KJ) = ARS(JJ,JGR,KJ+1) * V(KJ+1,JGR,JRUN) * D(KJ,JRUN)
    1 + RMC(KJ,JGR,JRUN) + AD(KJ,JGR,JALT) + D(KJ,JRUN) *
    2 (1.-V(KJ+1,JGR,JRUN)) * T(KJ+1,JGR,JRUN)
     GO TO 762
 761 CONTINUE
     ARS(JJ,JGR,KJ) = (ARS(JJ,JGR,KJ+1) * V(KJ+1,JGR,JRUN) * D(KJ,JRUN)
    1 + AD(KJ,JGR,JALT) + RMC(KJ,JGR,JRUN) + D(KJ,JRUN)
    2 * (1.-V(KJ+1,JGR,JRUN)) * T(KJ+1,JGR,JRUN)) *
    3 (1.-PROM(JGR+1,KJ,JRUN)) + PROM(JGR+1,KJ,JRUN) *
    4 ARS(JJ,JGR+1,KJ)
 762 CONTINUE
7580 IJNUM = IJNUM+1
 758 CONTINUE
     IF(JJ.LT.JLO) GO TO 7510
     DRS(JJ,JGR) = ARS(JJ,JGR,JJ) - RS(JJ,JGR,JJ)
     DELR(JJ,JGR) = BETA(JJ,JRUN) * RET(JJ,JGR,JRUN) *
    1 (DRS(JJ,JGR)/RS(JJ,JGR,JJ) - DRL(JJ,JGR)/RL(JJ,JGR))
     RPRIME(JJ,JGR) = RET(JJ,JGR,JRUN) + DELR(JJ,JGR)
     IF(RPRIME(JJ,JGR).GT.1.0) RPRIME(JJ,JGR) = CONT(JJ,JGR,JRUN)
     IF(RPRIME(JJ,JGR).LT.0.0) RPRIME(JJ,JGR) = 0.0
7510 JNUM = JNUM + 1
 751 CONTINUE
 715 CONTINUE
 880 IF(JALT.GT.3) GO TO 3429
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```
      DO 3424 IRETYR=21,30
      DO 3424 IJGR=1,6
      CONT(IRETYR,IJGR,JRUN) = RPRIME(IRETYR,IJGR)
 3424 CONTINUE
 3429 CONTINUE
      DO 763 JGR=1,6
      DO 763 IP=1,4
      POOL(IP,JGR,1) = STPOOL(IP,JGR,JRUN)
  763 CONTINUE
      DO 775 IYR=5,30                                          GARMY
      DO 764 JGR=1,6
      DO 766 IP=1,4
      POOL(IP,JGR,2) = POOL(IP,JGR,1)
  766 CONTINUE
      JLO = JTAB(JGR,1,JRUN)
      JHI = JTAB(JGR,2,JRUN)
      IF(IYR.LT.JLO+1) GO TO 765
      IF(IYR.GT.JHI) GO TO 7644
      TCONT(IYR,JGR) = (RPRIME(IYR,JGR) * POOL(1,JGR,1) +
     1 CONT(IYR,JGR,JRUN) * (POOL(2,JGR,1) + POOL(3,JGR,1) +
     2 POOL(4,JGR,1))) / (POOL(1,JGR,1) + POOL(2,JGR,1) +
     3 POOL(3,JGR,1) + POOL(4,JGR,1))
      GO TO 765
 7644 CONTINUE
      IF(IYR.NE.JHI+1) GO TO 764
      DO 7654 IP=1,4
 7654 POOL(IP,JGR,1) = 0.0
      GO TO 764
  765 CONTINUE
      IF(JGR.EQ.1.OR.JGR.EQ.6) GO TO 767
      DO 768 IP=1,3
      POOL(IP,JGR,1) = (1.-PROM(JGR+1,IYR,JRUN)) * CONT(IYR,JGR,JRUN) *
     1 POOL(IP+1,JGR,2) + PROM(JGR,IYR,JRUN) * CONT(IYR,JGR-1,JRUN) *
     2 POOL(IP+1,JGR-1,2)
  768 CONTINUE
      POOL(4,JGR,1) = (1.-PROM(JGR+1,IYR,JRUN)) * RPRIME(IYR,JGR) *
     1 POOL(1,JGR,2) + PROM(JGR,IYR,JRUN) * RPRIME(IYR,JGR-1) *
     2 POOL(1,JGR-1,2)
      GO TO 764
  767 CONTINUE
      IF(JGR.EQ.6) GO TO 770
      DO 771 IP=1,3
      POOL(IP,JGR,1) = (1.-PROM(JGR+1,IYR,JRUN)) * CONT(IYR,JGR,JRUN) *
     1 POOL(IP+1,JGR,2)
  771 CONTINUE
      POOL(4,JGR,1) = (1.-PROM(JGR+1,IYR,JRUN)) * RPRIME(IYR,JGR) *
     1 POOL(1,JGR,2)
      GO TO 764
  770 CONTINUE
      DO 772 IP=1,3
      POOL(IP,JGR,1) = CONT(IYR,JGR,JRUN) * POOL(IP+1,JGR,2) +
     1 PROM(JGR,IYR,JRUN) * CONT(IYR,JGR-1,JRUN) * POOL(IP+1,JGR-1,2)
  772 CONTINUE
      POOL(4,JGR,1) = RPRIME(IYR,JGR) * POOL(1,JGR,2) +
     1 PROM(JGR,IYR,JRUN) * RPRIME(IYR,JGR-1) * POOL(1,JGR-1,2)
  764 CONTINUE
      IF(IOFLET.EQ.1) GO TO 775
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      DO 776 IP=1,4
      ISYR = IYR + IP -1
      WRITE(6,210) ISYR,IYR,(POOL(IP,J,2),J=1,6)
  210 FORMAT(5X,I2,13X,I2,8X,5(F7.1,3X),F7.1)
  776 CONTINUE
  775 CONTINUE
      GO TO 449
  801 CONTINUE
      JGR = 6
      JLO = JTAB(JGR,1,JRUN)
      JHI = JTAB(JGR,2,JRUN)
      DO 800 JJ=JLO,JHI
      DO 804 KJ=JJ,JHI
      DO 808 IST=JJ,KJ
      RS(JJ,JGR,KJ) = RS(JJ,JGR,KJ) + RMC(IST,JGR,JRUN) *
     1 D(JJ,JRUN)**(IST-JJ)
      ARS(JJ,JGR,KJ) = ARS(JJ,JGR,KJ) + (RMC(IST,JGR,JRUN) +
     1 WD(IST,JGR,JALT)) * D(JJ,JRUN) ** (IST-JJ)
  808 CONTINUE
      RS(JJ,JGR,KJ) = RS(JJ,JGR,KJ) + RL(KJ+1,JGR) * D(JJ,JRUN)
     1 ** (KJ-JJ+1)
      ARS(JJ,JGR,KJ) = ARS(JJ,JGR,KJ) + (RL(KJ+1,JGR) + DRL(KJ+1,JGR))
     1 * D(JJ,JRUN) ** (KJ-JJ+1)
      IF(RS(JJ,JGR,KJ).LT.RS(JJ,JGR,31)) GO TO 802
      RS(JJ,JGR,31) = RS(JJ,JGR,KJ)
      T(JJ,JGR,1) = KJ
  802 IF(ARS(JJ,JGR,KJ).LT.ARS(JJ,JGR,31)) GO TO 804
      ARS(JJ,JGR,31) = ARS(JJ,JGR,KJ)
      T(JJ,JGR,2) = KJ
  804 CONTINUE
  800 CONTINUE
      DO 812 IJGR=1,5
      JGR = 6 - IJGR
      JLO = JTAB(JGR,1,JRUN)
      JHI = JTAB(JGR,2,JRUN)
      DO 816 JJ=JLO,JHI
      DO 820 KJ=JJ,JHI
      SAMEGR = 1.
      TOTGR = 0.0
      ATOTGR = 0.0
      DO 824 IST=JJ,KJ
      SAMEGR = SAMEGR * (1.0-PROM(JGR+1,IST,JRUN))
      TOTGR = TOTGR + SAMEGR * RMC(IST,JGR,JRUN) * D(JJ,JRUN) **
     1  (IST-JJ)
      ATOTGR = ATOTGR + SAMEGR * (RMC(IST,JGR,JRUN) + WD(IST,JGR,JALT))
     1 * D(JJ,JRUN) ** (IST-JJ)
  824 CONTINUE
      TOTGR = TOTGR + SAMEGR * RL(KJ+1,JGR) * D(JJ,JRUN) ** (KJ-JJ+1)
      ATOTGR = ATOTGR + SAMEGR * (RL(KJ+1,JGR) + DRL(KJ+1,JGR)) *
     1  D(JJ,JRUN) ** (KJ-JJ+1)
      DO 828 IST=JJ,KJ
      JST = KJ + JJ - IST
      SAMEGR = SAMEGR / (1.-PROM(JGR+1,JST,JRUN))
      FACTER = SAMEGR * PROM(JGR+1,JST,JRUN)
      TOTGR = TOTGR + FACTER * RS(JST,JGR+1,31) * D(JJ,JRUN) ** (JST-JJ)
      ATOTGR = ATOTGR + FACTER * ARS(JST,JGR+1,31) * D(JJ,JRUN) **
     1 (JST-JJ)
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828 CONTINUE
    RS(JJ,JGR,KJ) = TOTGR
    ARS(JJ,JGR,KJ) = ATOTGR
    IF(RS(JJ,JGR,KJ).LT.RS(JJ,JGR,31)) GO TO 832
    RS(JJ,JGR,31) = RS(JJ,JGR,KJ)
    T(JJ,JGR,1) = KJ
832 IF(ARS(JJ,JGR,KJ).LT.ARS(JJ,JGR,31)) GO TO 820
    ARS(JJ,JGR,31) = ARS(JJ,JGR,KJ)
    T(JJ,JGR,2) = KJ
820 CONTINUE
816 CONTINUE
812 CONTINUE
    DO 840 JGR=1,6
    JLO = JTAB(JGR,1,JRUN) + 1
    JHI = JTAB(JGR,2,JRUN)
    DO 844 JJ=JLO,JHI
    DRS(JJ,JGR) = ARS(JJ,JGR,31) - RS(JJ,JGR,31)
    DELR(JJ,JGR) = BETA(JJ,JRUN) * RET(JJ,JGR,JRUN) * (2.*DRS(JJ,JGR)/
   1 (RS(JJ,JGR,31) + ARS(JJ,JGR,31)) - 2.* DRL(JJ,JGR)/
   2 (2.* RL(JJ,JGR) + DRL(JJ,JGR)))
    RPRIME(JJ,JGR) = RET(JJ,JGR,JRUN) + DELR(JJ,JGR)
    IF(RPRIME(JJ,JGR).GT.1.0) RPRIME(JJ,JGR) = CONT(JJ,JGR,JRUN)
    IF(RPRIME(JJ,JGR).LT.0.0) RPRIME(JJ,JGR) = 0.0
844 CONTINUE
840 CONTINUE
    IF(JPRT.EQ.1) GO TO 880
    IF(JPRT.EQ.2) GO TO 890
    DO 852 IJGR=1,6
    JGR = 7-IJGR
    JLO = JTAB(JGR,1,JRUN)
    JHI = JTAB(JGR,2,JRUN)
    DO 856 JJ=JLO,JHI
    JJ1 = JJ - 1
    WRITE(6,120) NAME2(JGR),JJ,T(JJ,JGR,1),RS(JJ,JGR,31),JJ1,
   1 RL(JJ,JGR)
120 FORMAT(///,5X,'UNDER THE CURRENT SYSTEM A ',A3,
   1 'ENTERING YEAR OF SERVICE ',I2,'MAXIMIZES HIS',/,
   2 5X,'STREAM OF FUTURE EARNINGS BY LEAVING AT THE END OF YEAR',
   3 2X,F3.0,/,5X,'THAT MAX RETURN IS ',F9.0,
   4 ' THE RETURN FROM LEAVING AT THE END OF ',I2,' IS ',F9.0,//)
    WRITE(6,121)
121 FORMAT(10X,'ENTERING YEAR',5X,'RETURN FROM STAYING TO',5X,
   1 'END OF YEAR',//)
    DO 860 KJ=JJ,JHI
    WRITE(6,122) JJ,RS(JJ,JGR,KJ),KJ
122 FORMAT(16X,I2,16X,F9.0,16X,I2)
860 CONTINUE
856 CONTINUE
852 CONTINUE
890 CONTINUE
    DO 864 IJGR=1,6
    JGR = 7 - IJGR
    JLO = JTAB(JGR,1,JRUN)
    JHI = JTAB(JGR,2,JRUN)
    DO 868 JJ=JLO,JHI
    JJ1 = JJ - 1
    RSA = RL(JJ,JGR) + DRL(JJ,JGR)
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      WRITE(6,124) ALT(JALT),NAME2(JGR),JJ,T(JJ,JGR,2),ARS(JJ,JGR,31),
     1 JJ),RSA
  124 FORMAT(///,5X,'UNDER THE ',A4,' SYSTEM A ',A3,
     1 ' ENTERING YEAR OF SERVICE ',I2,'MAXIMIZES HIS',/,
     2 5X,'STREAM OF FUTURE EARNINGS BY LEAVING AT THE END OF YEAR',
     3 2X,F3.0,/,5X,'THAT MAX RETURN IS ',F9.0,
     4 ' THE RETURN FROM LEAVING AT THE END OF ',I2,' IS ',F9.0,//)
      IF(JPRT.EQ.3) GO TO 868
      WRITE(6,121)
      DO  872 KJ=JJ,JMI
      WRITE(6,122) JJ,ARS(JJ,JGR,KJ),KJ
  872 CONTINUE
  868 CONTINUE
  864 CONTINUE
      GO TO 880
  449 CONTINUE
      IF(ISKIP.EQ.1) GO TO 7777
      DO 100 JG=JLOWR,JUPPR
      WRITE(6,99)
   99 FORMAT(1H1)
      IF(JRUN.EQ.1) WRITE(6,102) NAME1(JG),ALT(JALT),JMETH
      IF(JRUN.EQ.2) WRITE(6,102) NAME2(JG),ALT(JALT),JMETH
  102 FORMAT(///,18X,'FOR GRADE ',A3,' ALTERNATIVE ',A4,
     * ' AND METHOD ',I1)
      WRITE(6,103) PR,CPI
  103 FORMAT(20X,'WITH PAY RAISE = ',F5.3,' AND CPI = ',F5.3)
      WRITE(6,106)
  106 FORMAT(/,10X,'ORIGNL',2X,'PREDIC',2X,'CHG IN',2X,' TOT ',
     1 3X,'RETRN F',2X,'ALTRT F',3X,'CHG IN',2X,'RETRN F',3X,'CHG IN')
      WRITE(6,108)
  108 FORMAT(5X,'YOS',3X,'RETN',4X,'RETN',4X,'RETN',4X,'CONT',
     1 3X,'STAYING',2X,'STAYING',3X,'RETURN',2X,'LEAVING',3X,'RETURN')
      JLO = JTAB(JG,1,JRUN)
      JHI = JTAB(JG,2,JRUN)
      DO 110 JY=JLO,JHI
      IF(JMETH.EQ.2) GO TO 4470
      WRITE(6,115)JY,RET(JY,JG,JRUN),RPRIME(JY,JG),DELR(JY,JG),
     1 TCONT(JY,JG),RS(JY,JG,31),ARS(JY,JG,31),DRS(JY,JG),RL(JY,JG),
     . DRL(JY,JG)
  115 FORMAT(5X,I3,4F8.4,5F9.0)
      GO TO 110
 4470 WRITE(6,115)JY,RET(JY,JG,JRUN),RPRIME(JY,JG),DELR(JY,JG),
     1 TCONT(JY,JG),RS(JY,JG,JY),ARS(JY,JG,JY),DRS(JY,JG),RL(JY,JG),
     2 DRL(JY,JG)
  110 CONTINUE
  100 CONTINUE
 7777 CONTINUE
      WRITE(6,303)
      WRITE(6,99)
  303 FORMAT(///,12X,'PRESENT VALUE OF LIFETIME CIVILIAN EARNINGS',/)
      IF(JRUN.EQ.1) WRITE(6,304)(NAME1(JNAME),JNAME = 1,6)
      IF(JRUN.EQ.2) WRITE(6,304)(NAME2(JNAME),JNAME = 1,6)
  304 FORMAT(5X,'YOS',4X,A3,5(6X,A3))
      DO 305 JJJ = 1,46
      WRITE(6,306) JJJ,(CIVPV(JJJ,JGRD,JRUN),JGRD = 1,6)
  306 FORMAT(5X,I3,6F9.0)
  305 CONTINUE
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 301 CONTINUE
     WRITE(6,2000) ALT(JALT)
2000 FORMAT(1H1,///,30X,'CONTINUATION RATES',/,34X,A4,1X,'PLAN')
     WRITE(6,2010) (NAME2(IK),IK=1,6)
2010 FORMAT(//,34X,'GRADE',/,8X,'YOS',2X,6(3X,A3,2X))
     DO 2015 IWK=1,30
     WRITE(6,2020) IWK,(TCONT(IWK,IG),IG=1,6)
2020 FORMAT(9X,I2,1X,6(F8.4))
2015 CONTINUE
     STOP
     END
EOF:689
0:
NO CORRECTIONS APPLIED.


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